CLAIMS:

1. A process for producing synthetic quartz glass, comprising the steps of feeding oxygen gas, hydrogen gas, and a silica-forming reactant gas from a burner to a reaction zone, flame hydrolyzing the silica-forming reactant gas in the reaction zone to form fine particles of silica, depositing the silica particles on a rotatable substrate in the reaction zone to form a porous silica matrix, and heating and vitrifying the porous silica matrix in a fluorine compound gas-containing atmosphere to form a fluorine-containing synthetic quartz glass, characterized in that

during formation of the porous silica matrix, the silica matrix and the flame of reactant gas from the burner are oriented to define an angle of 90 to 120° between their respective center axes so that the porous silica matrix has a density of 0.1 to 1.0 g/cm^3 with its distribution within 0.1 g/cm^3.

2. The process of claim 1 wherein a fluorine compound gas is also fed from the burner to the reaction zone along with the silica-forming reactant gas.

3. The process of claim 1, further comprising the step of heat treating the synthetic quartz glass in a hydrogen gas-containing atmosphere.

4. A synthetic quartz glass produced by the process of claim 1, which quartz glass has a hydroxyl group concentration of up to 10 ppm with its distribution within 1 ppm and a fluorine atom concentration of at least 500 ppm with its distribution within 500 ppm.

5. The synthetic quartz glass of claim 4 which has a refractive index distribution of up to 5×10^{-4} to light having a wavelength of 633 nm.

6. A quartz glass substrate for photomasks, made of the synthetic quartz glass of claim 4 which has a birefringence of up to 10 nm/cm to light having a wavelength of 633 nm.